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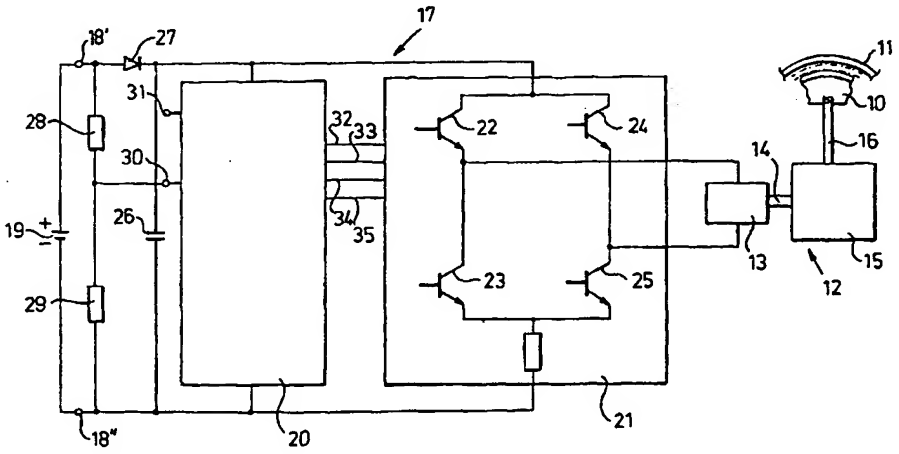

(57) Abstract

An electromechanical brake comprises at least one friction brake member (10), movable between an inactive rest position and an active working position, an actuator (12), connected to said brake member and provided with an electric force generating device (13), and an electric control and drive unit (17) for the force generating device (13). Said control and drive unit (17), which is provided with a supply voltage inlet (18', 18") connectable to an external supply voltage source (19), comprises an auxiliary voltage source (26) which can be charged from the external supply voltage source (19) via the supply voltage inlet (18', 18"), and monitoring means (20) for monitoring the voltage state at said inlet (18', 18") if the voltage across the supply voltage inlet (11', 18") falls below a predetermined lowest permitted value while the brake member (10) is in its rest position, said monitoring means (20) will cause a forced movement of the brake member (10) to its working position by supplying the required electric energy for this purpose to the force generating device (13) from the auxiliary voltage source (26).

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Electromechanical brake

The present invention relates to an electromechanical brake.

More particularly, the invention relates to such a brake of the kind comprising at least one friction brake member, movable between an inactive rest position and an active working position, an actuator, connected to said brake member and provided with an electric force generating device in order hereby to permit an electrically controllable movement of the brake member in each direction between said two positions, said actuator being arranged to hold the brake member releasably in each of said two positions unaided by said force generating device, and an electric control and drive unit for the force generating device, provided with a supply voltage inlet, intended to be connected to an external supply voltage source.

An advantage of brakes of the above kind is that electric driving energy need to be supplied to the force generating device only during the movement of the brake member between its two said positions, while any electric driving energy is not required to hold the brake member releasably in one or the other of said two positions. However, a serious disadvantage of previously known brakes of said kind is that, if during any interruption in the delivery of supply voltage from the external supply voltage source, the brake member is in its inactive rest position, the brake member will remain in said position and cannot be moved to its active working position in any other manner than possibly by means of a special manually operable member which is arranged to cause such a movement of the brake member in a purely mechanical way or through the action of means for transforming mechanical energy, manually generated by

means of said member, into electric energy.

The invention has for its purpose to provide an improved brake of the kind initially specified which is arranged to be activated immediately if the delivery of supply voltage from the external supply voltage source is interrupted or if the delivered supply voltage falls below a predetermined treshold value.

The brake according to the invention proposed for said purpose is primarily characterized in that said control and drive unit comprises an auxiliary voltage source which is arranged to be charged from the external supply voltage source when the supply voltage inlet is connected to the latter source, and monitoring means which are arranged to monitor the voltage state at the supply voltage inlet and to cause a forced movement of the brake member to its working position by supplying the required electric energy for such a movement of the brake member to the force generating device from said auxiliary voltage source, if the voltage appearing at the supply voltage inlet falls below a predetermined lowest permitted value while the brake member is in its rest position.

The invention guarantees an immediate application of the brake in the case of any interruption in the connection between the supply voltage inlet and the external supply voltage source as well as in the case of any unacceptable fall in the output voltage from the supply voltage source. As a consequence, the brake can be used for purposes for which it has previously not been possible to utilize brakes of the kind here at issue. For instance, the brake may advantageously be used as a combined emergency and parking brake in an electrically powered wheel chair.

In order to guarantee an unobjectionable function of the auxiliary voltage source, said voltage source

may suitably be connected to the supply voltage inlet via a diode which is arranged to prevent the auxiliary voltage source from being discharged through means connected to the supply voltage inlet.

The auxiliary voltage source may be formed either by a rechargable battery or by an energy storage capacitor.

Said monitoring means may preferably be formed by a microcomputer contained in the control and drive unit. Moreover, said monitoring means may suitably be arranged to monitor the voltage state at the supply voltage inlet through the intermediary of a voltage divider connected across said inlet. The utilization of such a voltage divider permits the monitoring means to monitor the voltage state at the supply voltage inlet by sensing only a fraction of the voltage applied on the supply voltage inlet.

The force generating device may advantageously consist of an electric motor. However, alternatively, it may be formed by one or more electromagnets.

The control and drive unit may suitably comprise a drive circuit consisting of an integrated circuit and containing an H-bridge connected to the motor.

Below the invention is further described with reference to the accompanying drawing which diagramatically shows an electromechanical brake according to an embodiment of the invention selected by way of example only.

In the drawing, reference numeral 10 designates a friction brake member which has been shown only partially and diagramatically and which for instance may consist of a brake shoe, adapted to be applied against the inner side of a cylindrical brake drum 11. By means of an actuator, generally designated 12 and connected to brake member 10, the brake member can be moved

between an inactive rest position, shown in full lines and in which the brake member is located at some distance from brake drum 11, and a working position, shown in dash-dotted lines and in which the brake member rests against the inner side of brake drum 11 and is in frictional engagement therewith.

Actuator 12 is provided with an electric force generating device which in the illustrated case has been assumed to consist of an electric motor 13. The output shaft 14 of motor 13 is connected to a self-locking mechanical transmission 15 which comprises a longitudinally displaceable operating rod 16, connected to brake member 10. The above design of actuator 12 makes is possible, by means of motor 13, to move brake member 10 in an electrically controllable manner in each direction between its rest position and its working position while simultaneously, as a consequence of the self-locking character of mechanical transmission 15, the brake member may be held releasably in each of said two positions unaided by motor 13. This means that electric driving energy need to be supplied to motor 13 only to move brake member 10 from its rest position to its working position or vice versa, while any electric energy need not be supplied to the motor to guarantee that brake member 10 will be releasably held in one or the other of said two positions.

Reference numeral 17 generally designates an electric control and drive unit for motor 13. This unit 17 has a supply voltage inlet which is formed by two terminals 18' and 18" and by means of which said unit may be connected to an external voltage source which in the illustrated example has been assumed to consist of a battery 19.

Control and drive unit 17 comprises on the one hand a control circuit 20 and, on the other hand, a

drive circuit 21 for motor 13, controlled by said control circuit. Control circuit 20 may advantageously consist of a microcomputer, while drive circuit 21 may consist of an integrated circuit, containing an H-bridge, formed by four transistors 22, 23, 24 and 25 and the appurtenant driving electronics, not shown in the drawing. By way of example, one suitable such integrated circuit is PBL3717 from Ericsson.

Control and drive unit 17 also comprises an auxiliary voltage source, consisting of a capacitor 26 and connected to the supply voltage inlet, formed by terminals 18' and 18", via a diode 27 which is arranged to permit capacitor 26 to be charged from the external voltage source 19 via said inlet but prevents the capacitor from being discharged through means connected across said inlet. Additionally, control and drive unit 17 also comprises a voltage divider, formed by two resistors 28 and 29, connected in series across the supply voltage inlet and arranged to apply a voltage, constituting a predetermined fraction of the voltage appearing across the supply voltage inlet, to a ccntrol input 30 of microcomputer 20.

Reference numeral 31 designates an additional control input of microcomputer 20 and reference numerals 32, 33, 34 and 35 designate four different connection lines between microcomputer 20 and drive circuit 21 through which the microcomputer may deliver the required control signals to transistors 22, 23, 24 and 25 to bring motor 13 to rotate in one or the other direction.

The manner of operation of the brake above described is as follows.

Initially, brake shoe 10 may be assumed to be located in its active working position, in which it rests against brake drum 11 and is in frictional engagement with said drum. Furthermore, the connection between

the external supply voltage source formed by battery 19 and the supply voltage inlet formed by terminals 18' and 18" may be assumed to be broken and capacitor 26 may be assumed to be discharged.

If the supply voltage inlet is now connected to battery 19 and the voltage across said inlet is sufficiently high, through lines 32 - 35, microcomputer 20 will apply the required control signals to drive circuit 21 to bring said circuit to deliver the required driving energy to motor 13 to rotate the motor in a direction for moving brake shoe 10 to its inactive rest position. As soon as brake shoe 10 has reached said position, the supply of driving energy to the motor may be interrupted since the brake shoe will be held in said position through the self-locking function of mechanical transmission 15. Simultaneously with the above described release of the brake, capacitor 26 will be charged from battery 19 via diode 27.

Via its input 30, microcomputer 20 will then monitor the voltage across the supply voltage inlet to determine whether said voltage remains at a value amounting to or exceeding a predetermined lowest permitted value. If, for instance due to an interruption in the connection between the supply voltage inlet and battery 19, the sensed voltage across said inlet falls below the lowest permitted value, microcomputer 20 will apply the required control signals to drive circuit 21 to bring said circuit to deliver the required driving energy to motor 13 to move brake shoe 10 to its active working position. The required driving energy to motor 13 will in this case be delivered from capacitor 26 which serves as an auxiliary voltage source. As a consequence of its self-locking function, transmission 15 will then hold brake shoe 10 in its working position until microcomputer 20 again applies the required control signals to drive

circuit 21 to cause a movement of the brake shoe to its inactive rest position.

In order to facilitate a manually controllable movement of the brake shoe between its said two positions, one may utilize a switch, connected in series with battery 19, or means, connected to the separate control input 31 and by which the voltage on said input may be shifted between two different predetermined values.

The invention is not restricted to the embodiment above described and shown in the drawing. Instead, many other embodiments are feasible within the scope of the invention as defined in the following claims. For instance, it could be mentioned that it is possible, instead of a force generating device consisting of an electric motor, to utilize such a device consisting of one or more electromagnets and that the brake member may be releasably held in each of its two said positions by other means than a self-locking mechanical transmission. Furthermore, the actuator may naturally be arranged to operate two or more movable brake members instead of only one single such member.

Claims

1. Electromechanical brake, comprising at least one friction brake member (10), movable between an inactive rest position and an active working position, an actuator (12), connected to said brake member and provided with an electric force generating device (13) in order hereby to permit an electrically controllable movement of the brake member in each direction between said two positions, said actuator being arranged to hold the brake member releasably in each of said two positions unaided by said force generating device, and an electric control and drive unit (17) for the force generating device, provided with a supply voltage inlet (18', 18"), intended to be connected to an external supply voltage source (19), characterized in that said control and drive unit (17) ccmprises an auxiliary voltage source (26) which is arranged to be charged from the external supply voltage source (19) when the supply voltage inlet (18', 18") is connected to the latter source, and monitoring means (20) which are arranged to monitor the voltage state at the supply voltage inlet and to cause a forced movement of the brake member (10) to its working position by supplying the required electric energy for such a movement of the brake member to the force generating device (13) from said auxiliary voltage source (26), if the voltage appearing at the supply voltage inlet falls below a predetermined lowest permitted value while the brake member (10) is in its rest position.

2. Electromechanical brake according to claim 1, characterized in that the auxiliary voltage source (26) is ccnnected to the supply voltage inlet (18', 18") via a diode (27) which is arranged to prevent the auxiliary voltage source (26) from being discharged through means ccnnected to the supply voltage inlet.

3. Electromechanical brake according to claim 1 or 2,

characterized in that the auxiliary voltage source is formed by a rechargable electric battery.

4. Electromechanical brake according to claim 1 or 2, characterized in that the auxiliary voltage source is formed by an energy storage capacitor (26).

5. Electromechanical brake according to any of the preceding claims, characterized in that said monitoring means are formed by a microcomputer (20) contained in the control and drive unit (17).

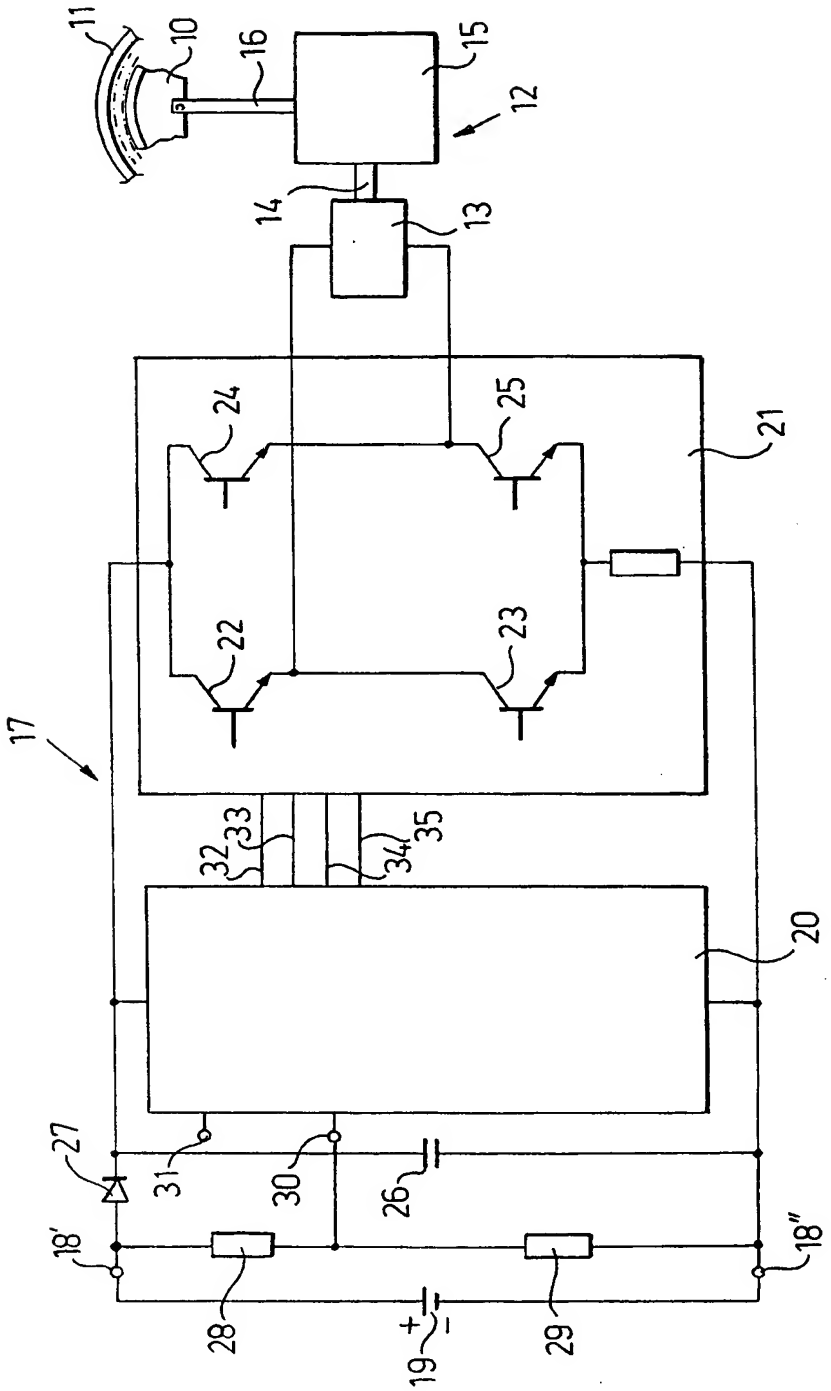
6. Electromechanical brake according to any of the preceding claims, characterized in that said monitoring means (20) are arranged to monitor the voltage state at the supply voltage inlet (18', 18") through the intermediary of a voltage divider (28, 29) connected across said inlet.

7. Electromechanical brake according to any of the preceding claims, characterized in that the force generating device is formed by an electric motor (13).

8. Electromechanical brake according to any of claims 1 - 6, characterized in that the force generating device is formed by one or more electromagnets.

9. Electromechanical brake according to any of the preceding claims, characterized in that the control and drive unit (17) comprises a drive circuit for the force generating device formed by an integrated circuit (21).

10. Electromechanical brake according to claim 9, characterized in that said integrated circuit (21) contains an H-bridge (22 - 25).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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/01103

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B60T 13/74
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B60T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9015743 A2 (VOLKSWAGEN AKTIEGESELLSCHAFT), 27 December 1990 (27.12.90), figures 1,3, claims 1, 6,7 --	1,5,7,9
X	DE 19643949 A1 (ITT AUTOMOTIVE EUROPE GMBH), 7 May 1998 (07.05.98), figure 1, claims 1,6,7,8 -- --------	1,3,4,6,7,9

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INTERNATIONAL SEARCH REPORT

Information on patent family members

30/08/99

International application No.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9015743 A2	27/12/90	EP 0479841 A	15/04/92
		JP 6503702 T	21/04/94
DE 19643949 A1	07/05/98	EP 0839701 A	06/05/98